

# Eugen GHEORGHIU

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**Nationality:** Romanian ; **Civil Status:** Married

**Education:** PhD in Theoretical Physics, 1994, Institute for Atomic Physics - Bucharest, Romania

## Relevant Professional experience:

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|--|--|---|---|
| University of Kyoto<br>JSPS fellow                                     | 1996- 1997   | Visiting professor                                    | Research in methods for monitoring and nonlinear analysis of cell cycle progression   |
| National Institute of Biotechnology                                    | 1997-2000  | Scientific Director                                   | Supervising and research  |
| <i>IC Biodynamics</i> <a href="http://www.biodyn.ro">www.biodyn.ro</a> | since 2000   | Director- <b>founder</b>                              | Supervising, training and research  |
| <i>University of Bucharest</i>   | 2003-<br>present   | Professor;<br><i>since 2004</i><br><i>PhD adviser</i> | <i>Supervising PhD students and research;</i><br>2003- 2008 <i>Teaching &amp; Coordination of the Master Programme in Biodynamics</i> |
| Invited researcher and professor<br>(short stages- up to 3 months)     | Binghamton Univ., US (2001); Catholic University Leuven, Belgium (2002 & 2003); National University of Singapore (2004 & 2005) |   |   |

## Research Interests include:

- Modelling & data analysis and experimental aspects of non-invasive analysis of dynamics of living cells and bio-interfaces using (coupled) electrical impedance spectroscopy, magnetic and optical (imaging) methods, including optical waveguides (e.g. SPR) microscopy and bio-affinity assays. The goal is to assess gentle (non-lethal) bioeffects of various stimuli including environmental ones using time based electro-optical biosensing (including cellular) analytical platforms
- Fast Point-of-care: (A) sensitive identification & quantitation of microbes (bacteria, fungi & viruses) and (B) Antibacterial & Antifungal Susceptibility Testing based on immune-magnetic capture, magneto-phoresis and electro-optical fingerprinting
- Electro-Optical (QPI or BFRL) analysis of (single) cell dynamics
- Electro-Optical Tomography at micro-scale

**Professional Honors:** “Stefan Procopiu” Award for Physics of the Romanian Academy, 1995

## Teaching:

### University of Bucharest,

(2004-2009) *Coordinator of the Master Program in Biodynamics*; Courses: Introduction in (non)linear data analysis; Electrochemical Impedance Spectroscopy to investigate bio-systems;

**2004– present: PhD Adviser, University of Bucharest**

### Polytechnic University of Bucharest

**2019- present,** Course on *Biodynamics* and related biomedical applications within the Master in modern technologies for Medical Engineering

**Invited Seminars on bio-impedance, biodynamics and electro-optical biosensors at:** University of Bologna and EC JRC Ispra (Italy);  
University of Hasselt (Belgium);  
University of Montpellier, University of Nancy and University of Perpignan (France); University of Wuppertal and Max Plank Institute for Biophysics-Frankfurt (Germany);  
Kyoto University (Japan);  
Karolinska Institute- Stockholm (Sweden);  
National University of Singapore;  
Emory & SUNY-Binghamton (US).

**Recent Oral Presentations & Invited talks:**

SPIE Photonics West, San Francisco, February 2018, “Optical and electrical mapping of live cell response to AC excitation using quantitative phase and optical waveguide assays”  
Photonics Europe, Strasbourg, April 2018, “Label-free imaging of cellular optical and electrical properties using quantitative phase imaging and AC field modulation assays”  
2019, Sept: RICCE 21, “Enhanced analytic performances of biosensors by modulating optical waveguides resonance with magnetic / electric alternating fields” & SIMI 2019, “Biosensing tools to assess the quality of aquatic environment”

**Promoter of over 20 International Research Grants** most representative:

**3 FP7: “DYNANO”** (Contract People ITN 2011- 289033);  
    **“PROARGUS” (coordinator)** (Contract-PIRG08-GA-2010-277126)  
    **“NanoMagma”** (Contract - NMP3-SL-2008-214107),  
**2 FP6: ROBIOS (coordinator)** Contract- INCO-2004-ACC-RSTP,  
    **CHARPAN,** (Contract - NMP2-CT-2005-515803)  
**and 1FP5: Aframilk-** (Contract- GRD1-2000-25801)

Co-Director, **TUMORANALYZER:** Response of in vitro hypoxic tumor models to potentially therapeutic compounds as revealed by an advanced analytical platform: 7/RO-CH/RSRP/2013,2013-15;

Co-Director, **Cell Biosensors for Detection of Chemical and Biological Threats, NATO-SPS 985042 & UEFISCDI-PN3-329/42/2017** (2016 - 2019)

**Director of over 20 National and International Research Grants** (during the last 10 years) including Director of the Complex Research Project BIOSCOPE, Contract No. 11/ 2012, PN-II-ID-PCCE-2011-2-0075

**Recent and ongoing National Projects:**

*Director* PATHSECURE, Development of a Point of Need portable system for rapid assessment of high threat pathogens including bioterrorism agents - Contract: 290PED/2020; PN-III-P2-2.1-PED-2019-5155;(03/08/2020 – 31/07/2022)

*Director*, FINDPATHOGEN, Advancement of a Portable System for Fast and Sensitive Detection of Pathogenic Cells – UEFISCDI-PN3-P2-2.1-PED-2016-1041, 2017-2018

#### **Recent & Ongoing International Projects:**

- Coordinator: SmartMatter- Core integration of novel functional, adaptive materials into a smart, highly sensitive analytical system for point of need environmental applications, M-EraNet (2020-22);
- Co-Pi: MarkerSense (attract-eu.com): SPR for early detection of biomarker proteins in whole blood (2019-20)

#### **Synergistic Activities**

- Since 2019- Member of the International Consortium of the Tim Hunt Research Institute of Life Science and Biotechnology, Jiangyin, China
- Co-founder Euroscience and member of Euroscience Governing Board (elected for three mandates)
- Expert of European Commission- Evaluator of Proposals on (nano)biosensing (1995-present), 2016-2020: H2020-FET OPEN
- 2016-2019 Member of ESF College of Expert Reviewers
- Review Panel member- European Science Foundation – EuroBioSAS (2010-2015)
- Member of Selection Committee for European Young Researchers' Award (2010-2016)
- Member of Editorial Board of: *Materials* (MDPI), *Physics in Medicine* (Elsevier), *Journal of Electrical BioImpedance*, *Romanian Journal of Biophysics*
- Guest Editor, Special issue **2020-22**: Advanced Designs of Materials, Devices and Techniques for Biosensing-MDPI, IF=3.375 ([https://www.mdpi.com/journal/materials/special\\_issues/materials\\_devices\\_techniques\\_biosensing](https://www.mdpi.com/journal/materials/special_issues/materials_devices_techniques_biosensing))
- Member of Evaluation Commissions of PhD thesis of: University of New South Wales, Sydney & Swinburne University of Technology, Melbourne Australia, National University of Singapore, Université Catholique de Louvain, Belgium Babes-Bolyai University, Cluj-Napoca and Polytechnic University of Bucharest.

## Patents and Patent Applications:

1. Ro Patent Application: A/00747/2021, Method to accurately derive the amplitude of a signal comprising repetitive rectangular pulses and of the temporal delays presented by a signal comprising distorted repetitive pulses versus a set of reference pulses, Authors: E. Gheorghiu, M. S. David, M. Gheorghiu
2. Ro Patent Application: A/00693/2021, Method to increase the sensitivity of optical waveguides analysis”, Authors: E. Gheorghiu, M. S. David, M. Gheorghiu, C. Polonschii
3. Ro Patent Application A/00577/2020 Method to collect, identify and quantitatively assess the concentration and the infectivity of pathogenic microorganisms with aerogenous spreading, Authors: E. Gheorghiu, M. Gheorghiu
4. **European Patent: EP2710359/2020**, Systems and Methods for Detection and Quantitation of Analytes Using Periodic Actuation, Authors: E. Gheorghiu, M. David, C. Polonschii, D. Bratu
5. US Patent Application BDN1901/2019, Systems and Methods for measuring cellular response to target analytes by controlled application of an oscillating stimulus, Authors: E. Gheorghiu, M. S. David, M. Gheorghiu
6. US Patent Application BDN1902/2019, Systems and methods for detecting bioactive compounds using sensors with pre-stimulated cells, Authors: M. Gheorghiu, E. Gheorghiu
7. Ro Patent Application Ro A/00224/2019, Method to measure the phase difference and the intensity introduced by the sample on beams with controlled polarization in a common-path geometry, Authors: E. Gheorghiu, M. S. David, M. Gheorghiu, C. Polonschii
8. Ro Patent Application A/00420/2018, Method and system for detection of bioactive compounds e.g. cytotoxic, using sensors with stimulated cells, Authors: M. Gheorghiu, E. Gheorghiu
9. Ro Patent Application A/00421/2018, Method for detection and quantitation of target analytes as well as for monitoring and increasing the yield of analyte capturing using a periodic stimulus, Authors: E. Gheorghiu, M. S. David, M. Gheorghiu
10. Ro Patent Application A/00422/2018, Method for assessing the viability of biological cells and for testing their susceptibility when exposed to a compound (e.g. antibiotic), Authors: E. Gheorghiu, M. S. David, M. Gheorghiu
11. Ro Patent Application A/00423/2018, Method and system for high precision measurement of the periodic variations of the electrical impedance of a sample, Authors: E. Gheorghiu, M. S. David, D. Bratu, M. Gheorghiu, C. Polonschii
12. Ro Patent Application A0031/2018: Portable device to measure optical waveguides including their resonances, Authors: E. Gheorghiu, M. S. David, M. Gheorghiu, C. Polonschii
13. Ro Patent Application A00651/2017: Method for measuring the distributions of electric fields and of refractive indices with high spatial and temporal resolution, Authors: E. Gheorghiu, M. S. David, C. Polonschii, M. Gheorghiu
14. **U.S. Patent 9,315,855/2016**: Systems and Methods for Detection and Quantitation of Analytes Using an Oscillating Stimulus, Authors: E. Gheorghiu, M. S. David, C. Polonschii, D. Bratu
15. Ro Patent Application A00502/2016: Method and system for illumination and reception for total internal reflection microscopy applications, Authors: E. Gheorghiu, R. Dabu, D. Ursu, M. Gheorghiu, M. S. David, C. Polonschii, D. Bratu
16. **Patent Ro 128065/2015**: Platform and method to monitor the quality of an aquatic environment based on analysis of the behavior of a fish population, Authors: E. Gheorghiu, C. Polonschii, D. Bratu

17. **Patent RO 127854/2014**- Method to assess the amount of target analytes by controlled periodic actuation, Author: E. Gheorghiu
18. **Patent RO127853/2014**- Device to assess the amount of target micro-organisms by controlled periodic actuation, Authors: E Gheorghiu, M. S David, C Polonschii and D Bratu
19. **Patent RO120867/14.03.2008**: Quantitative assessment of (bio)sensors by analysis of nonlinear frequency response, Authors: E. Gheorghiu, M. Gheorghiu, C. Balut, D. Bratu
20. **Patent RO120790/01.04.2003**: Method to detect analytes by analyzing the polarization impedance of the transducer/ sample interface, Authors: E. Gheorghiu, M. Gheorghiu, D. Bratu, A. Ursu
21. **Patent RO117877/30.08.2002**: Method for detecting target analytes in liquid media, Authors: E. Gheorghiu, M. Gheorghiu, C. Balut, D. Bratu
22. **Patent RO117986/29.11.2002**: Fast, high accurate method to measure AC impedances, Authors: E. Gheorghiu, D. Bratu, M. Gheorghiu, C. Balut

## Selected peer reviewed publications

1. David S., Gheorghiu M., Daakour S., Munteanu R.E., Polonschii C., Gaspar S., Barboiu M., Gheorghiu E., “Real Time SPR Assessment of the Structural Changes of Adaptive Dynamic Constitutional Frameworks as a New Route for Sensing”, *Materials* (2022) 15 (12), 483
2. Gheorghiu M., Polonschii C., Popescu O., Gheorghiu E., Advanced Optogenetic-Based Biosensing and Related Biomaterials, *Materials* (2021) 14 (15), 4151
3. Polonschii C., Gheorghiu M., David S., Gaspar S., Melinte S., Majeed H., Kandel M., Popescu G. and Gheorghiu E., High resolution impedance mapping using electrically-activated quantitative phase imaging, *Light: Science & Applications-Nature* (2021) 10:20
4. Gheorghiu E., Detection of pathogenic bacteria by magneto-immunoassays: a review, *The Journal of Biomedical Research* (2021), 1-7
5. Gheorghiu M., Stanica L., Ghinia Tegla M.G., Polonschii C., Bratu D., Popescu O., Badea T., Gheorghiu E., “Cellular sensing platform with enhanced sensitivity based on optogenetic modulation of cell homeostasis”, *Biosensors Bioelectronics*, 2020, 154, 112003
6. Gheorghiu M., Stanica, L; Polonschii C., David S., Ruckenstein A., Popescu O., Badea T., Gheorghiu E., “Modulation of cellular reactivity for enhanced cell-based biosensing”, *Analytical Chemistry*, 2020, 92, 1, 806-814
7. Gheorghiu E, Electrical impedance assays of blood cells, *Blood and Genomics*, 2020, 4(1): 1-8
8. Munteanu R.E., Ye R., Polonschii C., Ruff A, Gheorghiu M, Gheorghiu E, Boukherroub R, Schuhmann W, Melinte S, Gaspar S., “High spatial resolution electrochemical biosensing using reflected light microscopy”, *Scientific Reports* (2019), 9:15196
9. Rosu-Hamzescu M., Polonschii C, Oprea S., Popescu D., David S., Bratu D., Gheorghiu E., “High speed CMOS acquisition system based on FPGA embedded image processing for electro-optical measurements”, *Rev Sci Instr* (2018), 89, 065103-12;
10. Stanica L., Rosu-Hamzescu M., Gheorghiu M, Stan M., Antonescu L., Polonschii C, Gheorghiu E., “Electric Cell-Substrate Impedance Sensing of Cellular Effects under Hypoxic Conditions and Carbonic Anhydrase Inhibition”, *Sensors* (2017)
11. Stanica L, Gheorghiu M, Stan M, Polonschii C, David S, Bratu D, Dinischiotu A, Supuran CT , Gheorghiu E, “Quantitative assessment of specific carbonic anhydrase inhibitors effect on hypoxic cells using electrical impedance assays”, *J Enzyme Inhib Med Chem*, (2017) 32:1,1079-90
12. David S., Polonschii C., Gheorghiu M., Bratu D., Gheorghiu E., “Biosensing Based on Magneto-Optical Surface Plasmon Resonance”, in MiMB series, *Biosensors and Biodetection: Methods and Protocols*, IInd Ed., A. Rasooly & B. Prickril Eds., Springer, (2017) ISBN: 978-1-4939-6846-6.
13. Polonschii C., Gheorghiu E.,”A multitiered approach for monitoring water quality”, *Energy Procedia*, (2017), 112: 510 – 518, doi.org/10.1016/j.egypro. 2017.03.1138
14. David S., Polonschii C., Luculescu C., Gheorghiu M., Gáspár S., Gheorghiu E.,”Magneto-plasmonic biosensor with enhanced analytical response and stability”, *Biosensors and Bioelectronics* (2015) 63, 525–532
15. Bondarenko A. Cortes-Salazar F., Gheorghiu M. Gáspár S. Momotenko D. Stanica L. Lesch A., Gheorghiu E. Girault H. “Electrochemical push-pull probe: from scanning electrochemical microscopy (SECM) to multimodal altering of cell microenvironment”, *Anal. Chem.*(2015), 87, 4479–4486
16. Polonschii C., David S., Gáspár S., Gheorghiu M., Rosu-Hamzescu M., Gheorghiu E., “Complementarity of EIS and SPR to Reveal Specific and Nonspecific Binding When Interrogating a Model Bioaffinity Sensor; Perspective Offered by Plasmonic Based EIS”, *Anal. Chem.*(2014), 86 (17), 8553–8562

17. Gheorghiu M., David S., Polonschii C., Olaru A., Gaspar S., Bajenaru O., Popescu O. B., Gheorghiu E., "Label free sensing platform for amyloid fibrils effect on living cells", *Biosensors and Bioelectronics* (2014) 52, 89–97
18. Gheorghiu M., Enciu A.M., Popescu O. B., Gheorghiu E., "Functional and molecular characterization of A $\beta$ 42 effect on an in vitro epithelial barrier model", *Journal of Alzheimer's Disease* (2014) 38, 787–798
19. David S., Polonschii C., Gheorghiu M., Bratu D., Dobre A., Gheorghiu E., "Assessment of pathogenic bacteria using periodic actuation", *Front Cover Lab on a Chip* (2013), 13, 3192–3198;
20. Olaru A., Gheorghiu M., Polonschii C., David S. and Gheorghiu E., "Quality assessment of SPR sensors chips; case study on L1 chips" *Biosensors and Bioelectronics* (2013) 45C, 77-81
21. Gáspár S., Marty J. L., Gheorghiu E., "Cytochrome c-Based Amperometric Sensors for Superoxide Detection: Where Their Signal Comes From?", *Electroanalysis* (2013) 25, No. 2, 448 – 452
22. Polonschii C., Bratu D., Gheorghiu E., Appraisal of fish behaviour based on time series of fish positions issued by a 3D array of ultrasound transducers, *Aquacultural Engineering* (2013), 55 37– 45
23. Gáspár S., David S., Polonschii C., Marcu I., Gheorghiu M., Gheorghiu E., "Simultaneous impedimetric and amperometric interrogation of renal cells exposed to a calculus-forming salt", *Analytica Chimica Acta* (2012), 713, 115-120
24. Gheorghiu M., David S., Olaru A., Polonschii C., E. Gheorghiu, "Surface Plasmon Resonance Bioanalytical Platform to Appraise the Interaction Between Antimicrobial Peptides and Lipid Membranes" in *Optical Nano- and Microsystems for Bioanalytics*, Springer Series on Chemical Sensors and Biosensors, Vol. 10, Fritzsche, Wolfgang; Popp, Jürgen (Eds.) (2012) ISBN 978-3-642-25497-0
25. Gheorghiu E., "Relating membrane potential to impedance spectroscopy", *Journal of Electrical Bioimpedance*, 2, 93–97 (2011)
26. Sandu T., Vrinceanu D., Gheorghiu E., "Surface Plasmon Resonances of Clustered Nanoparticles" *Plasmonics* (2011), 6, 407-412
27. Sandu T., Vrinceanu D., Gheorghiu E., "Linear dielectric response of clustered living cells", *Phys. Rev E* 81 (2010), 0219131-02191311
28. Gheorghiu M., Olaru A., Tar A., Polonschii C., Gheorghiu E., "Sensing based on assessment of non-monotonous effect determined by target analyte: case study on pore forming compounds", *Biosensors and Bioelectronics* (2009), 24, 3517–3523
29. Olaru A., Gheorghiu M., David S., Wohland T., Gheorghiu E., "Assessment of the multiphase interaction between a membrane disrupting protein and a lipid membrane", *J. Phys. Chem. B*, 113 (2009), 14369–14380
30. Gheorghiu E, Gheorghiu M, David S, Polonschii C, *Biodysensing: sensing through dynamics of hybrid affinity / cellular platforms; towards appraisal of Environmental and Biological Risks of Nanobiotechnology in Silicon Versus Carbon Fundamental Nanoprocesses, Nanobiotechnology and Risks Assessment*, *NATO Science for Peace and Security Series, B: Physics and Biophysics* (2009) Magarshak Y., Kozyrev S. Vaseashta A.K. (Eds.) ISBN: 978-90-481-2522-7
31. Balan C., Broboana D., Gheorghiu E., Vekas L., Rheological characterization of complex fluids in electro-magnetic fields, *Journal of Non-Newtonian Fluid Mechanics* (2008) 154, 22–30
32. Gheorghiu M., David S., Polonschii C., Gheorghiu E. "Sensing at nanoscale via structured interfaces" *Eur Biophys J.* (2007) 36 S157

33. Balan C., Balut C., Gheorghe L., Gheorghiu E., Ursu G., "Experimental determination of blood permittivity and conductivity in simple shear flow", *Clinical. Hemorheology and Microcirculation* 30 (2004) 359-364;
34. Gheorghiu M., Gersing E., "Revealing alteration of membrane structure during ischemia using Impedance Spectroscopy", *J. Science and Technology* (2003), 24, 777-784;
35. Gheorghiu E., Andreescu D., Balut C., Ursu A., "Impedance Spectroscopy in Biodynamics: Detection of Specific Cells (pathogens) using Immunocoated Electrodes", *Journal of Science and Technology* (2003), 24 791-797;
36. Sadik O.A., Gheorghiu E., Xu H., Andreescu D., Balut C., Gheorghiu M., Bratu D. "Fast Dielectric Spectroscopy as a Dynamic Tool for In situ Monitoring of Bimolecular Reactions", *Anal. Chem* (2002), 74, 3142-3150;
37. Gheorghiu E., Balut C., Gheorghiu M. "Dielectric behaviour of gap junction connected cells: a microscopic approach", *Phys. Med. Biol.* (2002), 47 341-348;
38. Asami K., Gheorghiu E., Yonezawa T., "Real-time Monitoring of Yeast Cell Division by Dielectric Spectroscopy", *Biophys. J.* (1999), 76, 3345-3348;
39. Gheorghiu M., Gersing E., "A unitary, quantitative procedure to analyse impedance spectra of ischemic tissues", *Med. Biol. Eng. Comput.* (1999), 37, 94-95;
40. Bratu D., Gheorghiu E., "A new fast, wide range, portable bio impedance spectrometer", *Med. Biol. Eng. Comput.* (1999) 37, 126-127;
41. Gheorghiu E., Balut C. M., Asami K., "Monitoring cell cycle progression by impedance spectroscopy", *Med. Biol. Eng. Comput.* (1999) 37, 146-147;
42. Balut C. M., Gheorghiu E., "On the errors in determining cell properties from impedance data: theoretical and experimental aspects", *Med. Biol. Eng. Comput.* (1999) 37,166;
43. Gheorghiu M., Gersing E., Gheorghiu E., "Quantitative analysis of impedance spectra of organs during ischemia", *Annals of The New York Academy of Sciences* (1999) 873, 65-71;
44. Gheorghiu E., "On the limits of Ellipsoidal Models when Analyzing Dielectric behavior of Living Cells: Emphasis on Red Blood Cells", *Annals of The New York Academy of Sciences* (1999), 873, 262-268;
45. Gheorghiu E., Asami K., "Monitoring Cell Cycle By Impedance Spectroscopy: Experimental and Theoretical Aspects", *Bioelectrochem. Bioenerg* (1998), 45, 139-143;
46. Gheorghiu E., "Nonlinear Analysis of Synchronized Cell Suspensions: Experimental and Theoretical Aspects", in "Experimental Chaos IV", Eds. W. Ditto, M. Spano, L. Pecora, World Scientific Press (1998) 185-192;
47. Asami K., Gheorghiu E., Yonezawa T., "Dielectric Behavior of Budding Yeast in Cell Separation", *BBA* (1998), 1381, 234-240;
48. Vrinceanu D., Gheorghiu E., "Shape effects on the dielectric behavior of arbitrary shaped particles in particular references to biological cells", *Bioelectrochem. Bioener* (1996), 40, 167
49. Gheorghiu E., "Characterizing cellular systems by means of dielectric spectroscopy", *Bioelectromagnetics* (1996), 17, 475
50. Mihai C. M., Mehedintu M., Gheorghiu E., "The derivation of cellular properties from dielectric spectroscopy data", *Bioelectrochem. Bioener* (1996), 40, 187
51. Gheorghiu E., "Measuring living cells using dielectric spectroscopy", *Bioelectrochem. Bioener* (1996), 40, 133
52. Mehedintu M., Mihai C., Gheorghiu E., "Fast, in flux, procedure to measure and preserve the growing medium of a biological cell suspension", *Bioelectrochem. Bioener* (1996), 40, 181
53. Gheorghiu E., "Toward a new method to derive the invariant measures of (chaotic) dynamical systems. Application to living cell dynamics", *J. Tech. Physics* (1996), nr. 2



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55. Mihai C., Gheorghiu E., "Using of truncated models to derive the invariant measure of living cell dynamics", *J. Tech. Physics*, (1996) nr. 2
56. Gheorghiu E., "Dielectric behavior of spherical cell suspensions in relation to diffusion effects on nucleus presence", *Bioelectrochem. Bioener* (1995), 38, 123
57. Gheorghiu E., "The dielectric behavior of suspensions of spherical cells: a unitary approach", *J. Phys.A: Math. Gen.* (1994) 27, 3883
58. Gheorghiu E., "Diffusion effects in a charged membrane on the dielectric behavior of a spherical cell suspension", in "Charge and Field effects on Biosystems-4" Editors: M.J.Allen, S.F. Cleary & A.E.Sowers, World Scientific (1994), 39;
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